MULTIMEDIA UNIVERSITY®

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2016/2017

EMT2036 ENGINEERING MATHEMATICS III

(CE, EE, LE, NE, OPE, TE)

19 OCT 2016
09:00 A.M – 11:00 A.M.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of **4** pages including this cover page with **4** questions only.

2. Attempt all four questions. All questions carry equal marks and the distribution of marks for each question is given.

3. Print all answers in the answer booklet provided. Do show all relevant steps.

4. Programmable calculator is not allowed.

Question 1

(a) From a survey conducted on a computer manufacturing company, it is found that a random sample of 30 computers has an average lifetime of 788 days with standard deviation of 38 days.

(i) Find 95% confidence interval for the mean lifetime of all the computers produced. [6 marks]

(ii) Test the null hypothesis that the mean lifetime of all computers is 800 days against the alternative hypothesis that it is not equal to 800 days at α=0.05 level of significance. [7 marks]

(a) Using cylindrical coordinates, evaluate

$$\iiint_G x \, dV ,$$

where G is the region that lies below the plane $z = y + 2$, above the xy plane and between the cylinders $x^2 + y^2 = 1$ and $x^2 + y^2 = 4$.

[12 marks]

Continued ...

Question 2

(a) Evaluate $\oint_C \mathbf{F} \cdot d\mathbf{r}$ with $\mathbf{F} = \left(e^x + xy^2\right)\mathbf{i} + x\sqrt{y}\,\mathbf{j}$ and C is the arc of the curve $y = x^2$ from $(0,0)$ to $(2,4)$. [10 marks]

(b) Consider the vector field given by $\mathbf{F} = x^3\mathbf{i} + y^3z\,\mathbf{j} + z\,\mathbf{k}$ and D the solid enclosed by the paraboloid $z = x^2 + y^2$ and the plane $z = 2$. Given that σ is the outward-oriented surface of D with σ_1 as the portion of the paraboloid $z = x^2 + y^2$ and σ_2 as the portion of the plane $z = 2$ (refer to Figure Q2).

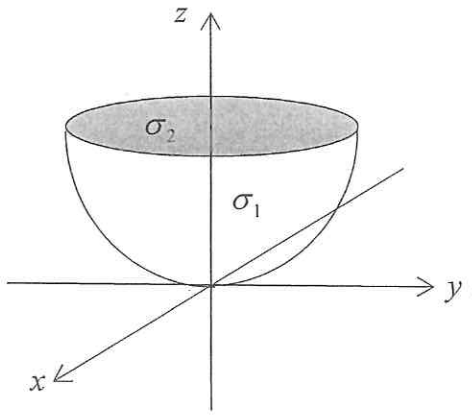

Figure Q2

(i) Set up the surface integrals $\iint_{\sigma_1} \mathbf{F} \cdot \mathbf{n}\, dS$ and $\iint_{\sigma_2} \mathbf{F} \cdot \mathbf{n}\, dS$, to determine the flux of $\mathbf{F}$ across the surfaces σ_1 and σ_2, respectively (Do Not solve the surface integrals).

[5 marks]

(ii) Use the Divergence Theorem to find the flux of $\mathbf{F}$ across the surface σ.

[10 marks]

Continued ...

Question 3

(a) Find the inverse of $A = \begin{bmatrix} 4 & -3 & 6 \\ -1 & 0 & 4 \\ 3 & 0 & -2 \end{bmatrix}$ using elementary row operations.

[16 marks]

(b) Solve the following system of linear equations using Cramer's Rule.

$$\begin{aligned} 4x - 3y + 6z &= 2 \\ -x \quad\quad + 4z &= 3 \\ 3x \quad\quad - 2z &= -1 \end{aligned}$$

[9 marks]

Question 4

(a) Find a matrix P that can diagonalize matrix $A = \begin{bmatrix} -2 & 5 & 0 \\ 2 & -5 & 8 \\ 3 & 0 & 7 \end{bmatrix}$, and determine its corresponding diagonal matrix D such that $D = P^{-1}AP$.

[15 marks]

(b) Given that $e_1 = \begin{pmatrix} 5 \\ 1 \end{pmatrix}$, $e_2 = \begin{pmatrix} 1 \\ -2 \end{pmatrix}$ are egienvectors of $A = \begin{bmatrix} 3 & 5 \\ 2 & -6 \end{bmatrix}$ corresponding to the eigenvalues $\lambda_1 = 4$ and $\lambda_2 = -7$, respectively. Find the general solutions for the system of differential equations:

$$\frac{dx_1}{dt} = 3x_1 + 5x_2$$

$$\frac{dx_2}{dt} = 2x_1 - 6x_2$$

Hence, find the particular solution of the system that satisfies the initial conditions $x_1(0) = 1$ and $x_2(0) = 0$.

[10 marks]

End of Paper